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U. S. DEPARTMENT OF AGRICULTURE
BIOLOGICAL SURVEY—BULLETIN No. 25

# BIRDS THAT EAT THE COTTON BOLL WEEVIL

## A REPORT OF PROGRESS

BY

ARTHUR H. HOWELL

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WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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# LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Biological Survey,
*Washington, D. C., May 3, 1906.*

Sir: I have the honor to transmit herewith for publication as Bulletin No. 25 of the Biological Survey a report of progress relating to the birds that feed on the boll weevil, by Arthur H. Howell. As a result of work in 1905 our knowledge of the part birds play in the destruction of the pest has been considerably extended, and several additions have been made to the list of species known to prey upon the boll weevil. The protection of these by law is earnestly recommended.

Respectfully,

C. Hart Merriam,
*Chief, Biological Survey.*

Hon. James Wilson,
*Secretary of Agriculture.*

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# BIRDS THAT EAT THE COTTON BOLL WEEVIL.

## INTRODUCTION.

The problem of controlling the ravages of the cotton boll weevil in the United States is of such moment that it is being studied by the Department of Agriculture from a number of different standpoints. One of these is the relation of birds to the weevil. Accurate information as to the value of our native birds as destroyers of this pest is of considerable importance to the cotton grower, but such information can be obtained only by means of careful and continued observation in the field, supplemented by study of the stomach contents of the birds. Field observations alone, unverified by stomach examinations, have proved unreliable. Birds may be observed picking insects from cotton plants, but it does not follow that the insects are boll weevils; nor is the statement that boll weevils have been found in birds' stomachs, if made by persons unaccustomed to the identification of insects, to be accepted as conclusive. Insect remains in a bird's stomach are nearly always in a more or less disintegrated condition, so that identification of the species is difficult and requires the services of a specialist.

Investigation of the problem was begun by the Biological Survey in the fall of 1904 under the direction of Vernon Bailey. The results of this study, with a summary of work done by the Bureau of Entomology, were published in a special bulletin by Mr. Bailey in 1905.[a] Stomachs of 38 species of birds were examined, and 11 species were found to have eaten boll weevils. The number of species known to feed on the weevil was increased to 20.

## PROGRESS OF THE INVESTIGATION.

During 1905 investigations were continued by the Biological Survey, and particular attention was devoted to the seasons about which least was known—namely, the period from February to October.[b] The

[a] Bulletin 22, Biological Survey.

[b] Field work was carried on by James H. Gaut in three localities in Texas for periods aggregating nearly six weeks, as follows: At Hempstead, February 21 to March 3; at East Bernard, May 2 to 17, and at Columbus, May 18 to June 1. A considerable number of birds' stomachs were obtained by him, but as no traces of the boll weevil were found in any of them they are not considered in the present bulletin.

work was taken up by the writer early in July and continued until October 20. Stomachs of 62 species of birds were collected and examined, of which 12 species and 108 individuals were found to have eaten boll weevils.[a] Detailed results of the summer observations will be given later.

## COMPARISON OF SUMMER AND WINTER CONDITIONS.

During the growing season of cotton the adult weevils are concealed the greater part of the time on the buds, or 'squares,' where the enfolding bracts afford almost complete protection from most of their enemies; this fact largely explains why comparatively few weevils are eaten by birds during the summer months. The amount of time they spend on the wing and the distance they fly from place to place are not well known, but it is only during the period of maximum infestation that any considerable proportion of the insects can be found in exposed situations. After the first hard frost, weevils begin to leave the cotton plants and seek sheltered places in which to hibernate. During this period their numbers are materially reduced, but in favored seasons many weevils successfully pass the winter in their retreats. Rubbish piles about the borders of fields apparently furnish the most desirable hibernating quarters, and in such situations the weevils are exposed more or less to the attacks of ground-feeding birds. They are said to make use also of the hiding places afforded by the cotton and corn stalks which have been left standing.

Investigations thus far made show that while fewer weevils are destroyed by birds in winter than in summer, the number of species of birds that feed upon them in winter is somewhat greater. The birds which eat boll weevils in winter and spring and up to the time of the breeding season of the insects are more important economically than those which eat them in summer, for the reason that during the season of nonactivity of the weevils a relatively long period must elapse before they can make good the losses in their numbers, while during the breeding season weevils multiply with astonishing rapidity.

## SUMMARY OF RESULTS.

As a result of the investigation of the relations of birds to boll weevils, details of which are given on succeeding pages, 28 species have been ascertained to feed on the weevil, as follows:

Killdeer.
Quail.
Nighthawk.
Scissor-tailed flycatcher.
Phœbe.
Least flycatcher.
Cowbird.
Red-winged blackbird.
Meadow lark.
Western meadow lark.

[a] Examination of the stomachs was conducted in the laboratory by Prof. F. E. L. Beal and W. L. McAtee.

Orchard oriole.
Baltimore oriole.
Bullock oriole.
Brewer blackbird.
Great-tailed grackle.
Savanna sparrow.
Lark sparrow.
White-throated sparrow.
Cardinal.
Pyrrhuloxia.
Painted bunting.
Dickcissel.
White-rumped shrike.
American pipit.
Mockingbird.
Brown thrasher.
Carolina wren.
Black-crested titmouse.

Thirteen of the above species fed on the weevil during the summer months, and 17 during the winter months, 2 species feeding upon the insect both in summer and winter. About 18 percent of the stomachs of these birds contained boll weevil remains, and the total number of weevils eaten by them amounted to 40 percent of the number of birds examined.

The orioles prove to be the greatest destroyers of weevils in summer, and their near relatives, the blackbirds and meadow larks, in winter. Orioles, because of their bright plumage, have until recently been extensively used for millinery purposes, and thus their numbers have been much reduced. Thousands were slaughtered, not alone in the United States, but in Central America, where they pass the winter. In view of their great value as weevil destroyers every effort should be made to prevent their destruction for any purpose whatever. The same suggestion applies with almost equal force to the nighthawk, which is strictly insectivorous and is shown to be an enemy of the boll weevil. During the migrations the nighthawk occurs in certain sections of the South in great numbers and is frequently shot wantonly or for food. The bird should everywhere and at all times be protected.

In the case of an insect so destructive as the boll weevil, which has thus far defied all attempts at restraint and is steadily extending its ravages into new territory, every natural check to its increase should be encouraged. Though the extent of the services rendered by the avian enemies of the insect may sometimes seem small or even insignificant, in reality their cumulative effect is very important.

Birds are not the least important of the boll weevil's natural enemies, and every species ascertained to feed on it should be protected at all times and places, not only in the cotton-producing area, but along their migration routes. Of the birds known to eat the weevil the following are at present not protected in Texas: Killdeer plover, cowbird, red-winged blackbird, Brewer blackbird, and great-tailed grackle, or 'jackdaw.' Others, including some of the most valuable species, though protected by statute, are often wantonly destroyed through ignorance of the important work they perform.

There can be no question as to the usefulness of the killdeer, and it should be included among the species protected at all seasons. The economic position of the various species of blackbirds is not so

clear. A study of their food made by Prof. F. E. L. Beal shows that some species, notably the Brewer blackbird and the great-tailed grackle, may at times be injurious to corn and other grain. However, the season in which blackbirds render the greatest service in destroying boll weevils, namely, winter and early spring, is not the season when they are likely to damage growing crops. And, furthermore, a very large proportion of the blackbirds leave Texas during the summer months. It seems, therefore, that in protecting them in winter, when they visit the cotton fields, the farmer is making no mistake.

In addition to protective bird laws the whole community should be informed as to the value of insectivorous species, with a view to the cultivation of popular sentiment in favor of their preservation. Without this sentiment, and the resulting coöperation on the part of the people, protective laws are of little value.

## STATUS OF THE SPECIES OF BIRDS KNOWN TO EAT THE BOLL WEEVIL.

In the summary which follows, the results obtained by previous investigations are combined with those secured during the past season, thus bringing together all that is at present known concerning the relations of birds to boll weevils. The tables at the close furnish a partial list of the birds which have been examined in the course of the investigations, arranged according to the seasons, and show at a glance the species that have eaten weevils, the number of individuals of each species eating weevils, and the number of weevils eaten.

### ORIOLES.

(*Icterus.*)

Observations carried on in 1905 indicate that in summer the birds most useful in destroying boll weevils are the three species of orioles occurring in the cotton belt of Texas—the orchard oriole, the Baltimore oriole, and the Bullock oriole. Of these the orchard oriole, although apparently less numerous than the Bullock oriole, is more generally distributed over the cotton-growing area, and is also the one which is the most successful weevil destroyer. Of the 84 specimens of this bird examined, 26, or about 31 percent, had eaten boll weevils; the total number of weevils taken by the 26 birds was 47, an average of nearly 2 to a bird, or 56 percent of all the birds examined.

The Baltimore oriole occurs as a summer resident in Texas only in the extreme northern and eastern portions, but during the migrations it is common throughout the State as far west at least as Karnes County. The 27 stomachs examined were taken between August 31 and September 22; six of them contained boll weevils, the total number of weevils found being 10, which is 37 percent of the number of birds examined.

The Bullock oriole is abundant in western Texas, but is not found much to the eastward of the longitude of Corpus Christi. It is abundant at Beeville and Runge, but is very rare at Cuero. Of the 144 specimens examined, 39, or about 27 percent, had eaten weevils; the total number of weevils eaten was 131, which is an average of more than 3 to a bird, or 91 percent of the number of birds examined.

All three species of orioles are migratory and spend only the spring and summer months in Texas. They usually arrive from the south between the 10th and 20th of April and depart late in September. It is unfortunate for the cotton growers that these useful birds do not remain in the State throughout the year, and it is likewise unfortunate that over the greater part of the cotton belt only one species, and that the smallest, is regularly found.

## BLACKBIRDS AND MEADOW LARKS.

The blackbirds and meadow larks, which belong to the same family as the orioles (*Icteridæ*), seem to occupy a position complementary to that of the orioles as boll weevil destroyers—that is to say, they continue during the winter the good work which the orioles do in the summer. Nine species of this group occur abundantly in Texas in winter, and six of these are known to eat the boll weevil.

The meadow larks are represented by several slightly different forms or species, but since the food habits of all are practically identical they may be considered together. Two hundred and fifty-seven specimens have been examined, and of these, 40, or 15 percent, had eaten boll weevils, the total number of weevils eaten being 50. Examination of the records of the larks collected by Bailey in November and December discloses an interesting fact, namely, that about as many weevils were taken by them before the first hard frost as after the frost. This shows that the larks are able to find the weevils while they are feeding on the cotton plants as well as while they are hibernating, and indicates that wherever the larks occur in summer in the cotton belt they may be depended on to assist in the destruction of weevils. The greater portion of central and southern Texas is, however, deserted by the larks during the breeding season and until the middle or latter part of October. None were seen by the writer at any of the localities visited in the summer of 1905, except on the prairies between Richmond and Columbus.

Four species of blackbirds are known to consume boll weevils, the most important of which seems to be the Brewer blackbird (*Euphagus cyanocephalus*). Ten stomachs of this bird were examined by assistants of the Bureau of Entomology, and five of them contained a total of 11 boll weevils. This is the only species collected in winter in which the number of weevils eaten averages more than one to a bird, and if further investigations show this ratio to be the rule these blackbirds

must be considered among the most useful of the winter visitants to Texas.

The big 'jackdaw,' or great-tailed grackle (*Megaquiscalus major macrourus*), was found to capture boll weevils in February, two of the eight birds taken in that month having eaten one weevil each. Six stomachs of the bird taken in summer contained no weevil remains.

The red-winged blackbird (*Agelaius phœniceus*) shows a smaller percentage of weevils taken than most of the other species of this family, but the enormous numbers of these birds which visit the cotton fields during the migrations give to their work a place of some importance. Sixty-three stomachs, nearly all taken in the fall and winter, have been examined, and two of them contained boll weevils.

The cowbird (*Molothrus ater*) is the only blackbird known to eat weevils both in summer and winter, but the number consumed in each case is small. Forty stomachs of this bird collected in winter showed only 1 weevil in the contents, and 54 stomachs taken in summer showed three containing 1 weevil each.

### SPARROWS, GROSBEAKS, ETC.

(*Fringillidæ.*)

The members of this family are among the most abundant and generally distributed of Texas birds. Five species have been collected during the summer months and nine during the winter months. All five species taken in summer were found to have eaten the boll weevil, but in nearly every case the consumption of weevils was small. The only species which seems to feed upon them regularly at this season is the painted bunting, and considering the abundance of these birds and the fact that they feed extensively in the cotton fields, they must be considered an important factor in reducing the numbers of weevils. Eighteen birds, or nearly 17 percent of the number examined, had eaten boll weevils, but in only one instance was more than one weevil taken by a single bird.

The other species of this family which feed upon the weevil in summer are the western lark sparrow, the dickcissel, the cardinal, and the pyrrhuloxia; in winter, the white-throated sparrow and the western lark sparrow. The number of weevils eaten by all of these is insignificant.

### FLYCATCHERS.

(*Tyrannidæ.*)

About ten species of flycatchers occur commonly in Texas, but only six of them are summer residents. Since these birds habitually capture their prey on the wing, they would not be expected to destroy large numbers of boll weevils, which, except during their annual

migration, fly but little. Two species have been found to capture the weevils in summer and one species in winter.

The least flycatcher does not breed in the State, but is present in small numbers during the migration in August and September, and probably also in spring. In spite of its small size and aerial feeding habits the number of weevils eaten by this bird amounts to over 100 per cent of the number of birds examined, or an average of more than two weevils to each bird eating them.

The scissor-tailed flycatcher, although an abundant species, apparently destroys very few boll weevils. Only 4 of the 64 birds examined had eaten weevils, the total number of weevils eaten being 6.

The phœbe is the only flycatcher which passes the winter months in Texas. Thirteen stomachs taken in November and December have been examined, three of which contained one boll weevil each. This bird does not occur in Texas during summer.

### NIGHTHAWK.

(*Chordeiles virginianus henryi.*)

The number of stomachs of this bird examined is too small to definitely settle its status as a boll weevil destroyer, but the fact that two of the four birds examined had eaten weevils, one having taken six weevils at a meal, indicates that the species is probably, at least at certain seasons, one of the most important enemies of the pest. This evidence should serve as an effective argument in favor of the preservation of the nighthawk.

These birds, commonly known as 'bull bats,' are often killed for food, particularly in Louisiana, Florida, and other Southern States, and they frequently serve also as targets for sportsmen who wish to try their skill as wing shots. In view of their importance as insect destroyers, nighthawks should at all times be rigidly protected.

### QUAIL, OR BOBWHITE.

(*Colinus virginianus texanus.*)

Much has been written concerning the quail as a destroyer of boll weevils, and many persons believe that it consumes them in large numbers. Stomach examinations, however, fail to substantiate this theory, for among 144 stomachs examined only one contained a boll weevil. The bird that ate this one was killed at Seguin in November by Vernon Bailey. There is still one season of the year during which the quail has been imperfectly studied, namely, the period from January to June, inclusive, and it is possible that investigation during those months may result in a different showing for the bird. The ground-feeding habits of quail make it practically certain that few if any boll weevils are taken by them in summer.

### KILLDEER.

(*Oxyechus vociferus.*)

One killdeer taken in February was found to have eaten three boll weevils. Further observations at the same season may not improbably produce additional evidence of this bird's value as a weevil destroyer. The killdeer frequents plowed fields, often in large numbers, and the destruction of weevils at the period of spring plowing is a highly important service. The present game law of Texas affords no protection to this bird, a defect which should be remedied by legislation. Meanwhile an enlightened public opinion should serve to prevent its destruction for any purpose.

### MOCKINGBIRD.

(*Mimus polyglottos.*)

In view of the abundance of the mockingbird in and about the cotton fields, both in winter and summer, a study of its food habits with relation to the boll weevil is especially important. Sufficient data were obtained in the summer of 1905 to demonstrate that this bird feeds only sparingly upon the weevils at that season. Of the stomachs examined, only four, or about 5 per cent of the total number, contained boll weevils. Specimens taken in winter are too few to furnish conclusive evidence as to the mockingbird's value at that season. Only 11 winter specimens have been examined, and of these 2 contained 1 boll weevil each.

### OTHER SPECIES.

There remain to be mentioned five species of birds, belonging to as many different families, which have been found to eat the boll weevil. They are the white-rumped shrike, the American pipit or titlark, the brown thrasher, the Carolina wren, and the black-crested titmouse. The most useful of these seem to be the titlark and the Carolina wren. The importance of both has been emphasized by Mr. Bailey in a previous bulletin, and no additional evidence has since been obtained. The titlark (*Anthus pensilvanicus*) is an abundant winter resident, and of the eight specimens collected three had eaten boll weevils.

The Carolina wren (*Thryothorus ludovicianus*) is common in winter, but rather rare in summer. Of the seven birds killed in winter five had eaten boll weevils.

The white-rumped shrike, or 'loggerhead' (*Lanius ludovicianus excubitorides*), was ascertained by assistants of the Bureau of Entomology to feed on boll weevils, two birds taken in December having captured one and four weevils, respectively. Examination of additional mate-

rial, including nine stomachs taken in summer, furnishes no additional records of boll weevils eaten by this bird.

The two remaining species, the brown thrasher and the black-crested titmouse, find a place in the list of boll weevil destroyers on the strength of having eaten a single weevil each.

## RESULTS OF OBSERVATIONS IN 1905.

### STATUS OF THE BOLL WEEVIL.

The winter of 1904–5 was unusually severe in Texas, and the spring was remarkable for excessive rainfall over a large part of the cotton-growing area of the State. The months of July and August were characterized by extremely hot, dry weather. To what extent the winter climatic conditions reduced the numbers of weevils it is difficult to state, but it is certain that during the spring and early summer of 1905 weevils were much less numerous than they usually are at that season. This is shown both by the comparatively slight amount of damage done to the cotton crop during the early part of the growing season and by the small number of adult weevils found in July in many cotton fields known to have been seriously infested at a corresponding date in 1904. The entire absence of boll weevil remains from the stomachs of many species of birds known to eat the boll weevil, taken in February, March, and May, also indicates the extreme scarcity of the weevils at that season. Gaut examined several thousand young cotton plants at Columbus in May and was unable to find a single weevil. The writer visited the same locality the last week in July and found the infestation even then very slight. This was true of a number of other widely separated localities visited during June and July.

It is a well-established fact that dry, hot weather during the summer months is extremely effective in checking the increase of boll weevils, and their scarcity during the summer of 1905 is partially explained by the prevalence of such weather. While in some localities during the late summer, weevils increased sufficiently to do a moderate amount of damage, at other localities which had suffered greatly from their ravages in 1904 the damage during 1905 was inconsiderable, and even as late as September very few adult weevils could be found at these localities.

The entire season, therefore, was not favorable for obtaining conclusive results with regard to the relations of birds and weevils. Observations during a season in which weevils are more abundant would doubtless show a larger number of species of birds feeding upon them and a greater number of weevils consumed per bird.

### CONDITIONS OF BIRD LIFE IN THE SUMMER OF 1905.

Birds were abundant at only two localities visited in the summer of 1905. At three localities they were moderately numerous, while at five localities they were very scarce. During the month of July, which includes the last part of the breeding season of most species, they were scarce at all localities visited. At Gurley, Texas, on July 20, a count was made of all the birds seen to visit a large cotton field in the river bottom, bordered on two sides with woods and thickets. Forty individuals of 10 species were noted in about six hours in the area under observation, which included about 100 acres. This result is fairly typical of conditions prevailing in other localities visited during the same month, except in regions where the presence of cotton worms offered an especially attractive food supply.

The greater part of August and September was spent at two localities in the arid mesquite belt of Texas—Beeville and Runge—and here birds, both resident species and migrants, proved to be abundant. Between September 23 and October 20 a number of different localities were visited, from Medina County on the west to Waller and Grimes counties on the east, and at every place a marked scarcity of bird life in and about the cotton fields was noted. Peculiarities in the distribution of the food supply, not as yet well understood, probably account in a measure for this scarcity. The tendency of certain species of birds after the breeding season to wander in search of food is quite pronounced. This habit is well illustrated by observations on the varying abundance of cuckoos, mentioned later.

### SUMMARY OF OBSERVATIONS IN 1905.

**Cuero, July 6–7.**—At this time the cotton plants were in fine condition, 3 to 4 feet high and full of blossoms and bolls. Weevils were very scarce, some fields being moderately infested and others not at all. No adult weevils could be found, and the average number of larvæ in fallen squares was about 12 to every 100 hills.

Birds were not abundant, and practically the only species seen feeding among the cotton plants was the orchard oriole. Of this species only one small flock was seen, and but one of those taken had eaten a boll weevil.

**Gurley, July 10–22.**—Cotton was in about the same condition here as at Cuero the previous week, perhaps a little less advanced.

Weevils were more abundant than at Cuero, though it was practically impossible to find adults. Forty hills in the worst infested fields were carefully searched without finding a single individual. Examination of all the fallen squares under 20 hills produced 34 larvæ, 4 of which were dead.

Birds were fairly common, and the following species were seen in the cotton fields: Quail, downy woodpecker, scissor-tailed flycatcher,

wood pewee, orchard oriole, lark sparrow, cardinal, painted bunting, purple martin, and mockingbird. The orchard oriole and the painted bunting were the most numerous and were the only ones seen feeding among the cotton plants. Of the stomachs examined from this locality only about 5 percent contained boll weevil remains. Four of the 18 orchard orioles examined had eaten a total of 6 boll weevils, and 2 of the 20 painted buntings examined had eaten 1 weevil each.

**Cameron, July 24–26.**—Cotton was in the same flourishing condition here as at Cuero and Gurley.

Weevils were by this time quite numerous. Twenty-five hills of tall cotton in a bottom-land field were searched and 9 adult weevils found, most of them crawling on the upper part of the stalks. Over 50 percent of the squares in this field were infested.

Birds were rather scarce, the only species which were at all numerous in the cotton fields being the orchard oriole, lark sparrow, scissor-tailed flycatcher, and quail. Of the 9 orchard orioles taken, 4 had eaten a total of 7 weevils. One painted bunting and 1 least flycatcher were taken, each of which had eaten a boll weevil.

**Columbus, July 28–29.**—Cotton was well advanced here, as at localities previously visited, but many of the fields had been attacked by the cotton leaf-worm, which proved to be very attractive food for the birds. Weevils were very scarce, some fields being very slightly infested, others containing from 5 to 10 percent of infested squares. Birds also were rather scarce, the only species seen in any numbers being the orchard oriole. Of 8 orioles examined, 2 were found to have eaten 1 weevil each.

**Beeville, August 3–22.**—During this period cotton picking was in full progress, and although in some fields the dry weather was beginning to retard the formation of new buds, many blossoms were opening every day.

Weevils were abundant and quite evenly distributed. On August 7 the fallen squares were collected from 20 hills of cotton, and in them were found 74 weevil larvæ, 39 of which were dead, evidently as a result of the hot weather. On August 20, 50 hills were examined for adult weevils, and 43 individuals found. The cotton leaf-worm had appeared only in very small numbers and in isolated spots.

Birds were abundant about the borders of the fields, in the mesquite thickets, and along roadsides. Large numbers of certain species also visited the cotton fields daily. Of the birds collected here, about 15 percent had taken the boll weevil, 41 individuals of 8 species having eaten a total of 129 weevils. During the early part of the month (August) the most abundant species of bird in the cotton fields was the painted bunting (*Cyanospiza ciris*). From 100 to 200 of these birds were seen in a single field nearly every morning. After about

the middle of the month, however, their numbers became much reduced, and by the 20th the average number seen in a day was not over 15. To some extent they fed on the ground, but spent much time climbing among the cotton stalks. They were partial also to weed patches. Thirteen birds, or about 15 percent of those examined, had eaten weevils, only one having taken more than a single weevil at a meal.

Even more abundant than the painted bunting was the lark sparrow (*Chondestes grammacus strigatus*), but unfortunately its ground-feeding habits preclude the possibility of its destroying the boll weevil on a large scale. Lark sparrows fairly swarmed along roadsides and in the more open portions of cotton fields, but only one of those examined contained a boll weevil.

The dickcissel (*Spiza americana*), another of the native sparrows, having habits somewhat similar to those of the lark sparrow, was found in the cotton fields in considerable numbers. Its record as a weevil consumer was somewhat better than that of the lark sparrow, for of the 19 birds examined 2 had eaten 1 weevil apiece.

One of the commonest birds at Beeville was the handsome pyrrhuloxia (*Pyrrhuloxia sinuata texana*), a large, thick-billed sparrow or grosbeak, related to the cardinal. The favorite haunts of these birds are the mesquite thickets, but they not infrequently visit the cotton fields. Two of those collected had each eaten a boll weevil.

The birds which proved to be the most important enemies of the boll weevil were the Bullock oriole (*Icterus bullocki*) and the orchard oriole (*Icterus spurius*), but unfortunately neither of these was very abundant. The orchard oriole, as in other localities where observations were made, habitually fed among the cotton stalks. Seventeen individuals were collected, and of these, 8 had eaten a total of 23 weevils. The largest number taken by a single bird was 7, and another had taken 6. The Bullock orioles, though more numerous than their smaller cousins, were seen less frequently in the cotton, their favorite haunts being the mesquite thickets. Twenty-seven individuals were collected in and near the cotton fields, and of these 27 birds 12 had eaten a total of 80 weevils. The greatest number eaten by a single bird was 41, and 2 others had eaten 11 and 9, respectively. These three birds, all of which were adults, were taken, together with five young birds, about 9 a. m. on August 16, while feeding in a cotton field. Of the five young, one had eaten two weevils and another three. These records would seem to show that the orioles know perfectly well where the weevils hide and seek them as a chosen article of food. At this season practically all the weevils are concealed beneath the enfolding bracts of the buds, or 'squares,' and it is improbable that a bird could capture as many as 41 during a single morning without opening the bracts in search of them. It

is significant also that the adult orioles, naturally having a better idea of where to hunt for weevils, consumed a much larger number of them than the young ones.

In addition to the four species of sparrows and two species of orioles found feeding on the weevils, there were also two species of flycatchers which captured them in small numbers. The scissor-tailed flycatcher (*Muscivora forficata*), though quite numerous in the pastures and along roadsides, visited the cotton plants very infrequently. Eleven individuals were collected, one of which had taken two boll weevils, and this one, strangely enough, was taken in a mesquite pasture at some distance from the cotton fields. The least flycatcher (*Empidonax minimus*), which was present in small numbers as a migrant, was occasionally seen to visit the cotton stalks, and of the three individuals collected two had taken boll weevils, one having eaten four, the other, one.

In addition to the birds already mentioned, the following species were more or less numerous in the cotton fields: Mockingbird, quail, yellow warbler, great-tailed grackle, cardinal, and curve-billed thrasher.

**Runge, August 23–September 5; September 11–23.**—During the first half of this period the growth of cotton had practically ceased, as the result of protracted drought. During the latter half, after a few light showers, the cotton plants began to put forth new buds and leaves. The cotton leaf-worms were very abundant at this locality; nearly all the fields had been attacked by them, and over large areas the plants had been entirely denuded of leaves and buds.

Weevils were quite abundant, but by reason of the ravages of cotton worms they had been forced to concentrate on the small patches of cotton containing leaves and buds. In such places they averaged about 2 weevils to a hill, the greatest number found in one spot being 19 on 5 hills. In the fields where cotton worms were still at work the weevils averaged about one to every two hills.

Birds were abundant in and about the cotton fields, and in the mesquite thickets. Cotton worms furnished a much more attractive and easily obtained food supply for the birds than weevils, as was shown both by field observations and by stomach examinations. Birds were much more numerous in fields infested with the cotton worms than in those which were uninfested, and in the case of certain species their presence or absence in a given locality was largely determined by the abundance of these insects. This was notably true of the yellow-billed cuckoos, which on August 23 were found in large numbers about an isolated field where cotton worms were abundant; but on September 2, after this brood had all pupated, not a single cuckoo could be found there, although they were still numerous in fields a few miles away.

Cotton worms were contained in the stomachs of nearly every species of bird collected at Runge, and they formed a large percentage

of the food of many species, notably the cuckoos, orioles, and mockingbirds, which were the commonest birds in the fields. The consumption of weevils by the birds therefore was probably less than it would have been had there been no cotton worms.

Nine species of birds were found feeding on weevils in this locality, 52 individuals, or more than 12 percent of those examined, having eaten a total of 88 weevils. As in other localities visited, orioles were the greatest consumers of weevils, although the proportion of weevils to birds killed was larger in the records of the nighthawk and of the least flycatcher.

The nighthawk (*Chordeiles virginianus henryi*) was quite numerous, but unfortunately it was not suspected of eating weevils, so that only four specimens were taken. Of these, 2 had eaten weevils; one collected on August 25 had eaten 6, and one on September 15, one weevil. The first of these was shot while flying over a cotton field, the other while resting on a tree, both at about 10 a. m. In the first instance 2 of the 6 weevils were almost entire, showing that they had been captured only a short time before. Since these birds invariably feed on the wing, the weevils must have been flying at the time they were captured.

The least flycatcher was present in small numbers, and 4 individuals were taken, 2 of which had eaten weevils—one eating 4, the other, one. The scissor-tailed flycatcher, a much more abundant species, captured only a small number of weevils. Of the 30 individuals collected, 2 had eaten a total of 3 weevils.

Three species of orioles were present at this locality—the orchard oriole, the Baltimore oriole, and the Bullock oriole, the last being the most abundant and also the greatest destroyer of weevils. Of 30 orchard orioles examined, 7 had eaten a total of 8 weevils. In this portion of Texas the Baltimore oriole is a migrant only. The first arrivals from the North were seen on September 13, and during the next ten days they were common. Five of those examined had eaten a total of 9 weevils. The Bullock oriole is a common breeder here, and they were still numerous at the time of the writer's departure. Although partial to mesquite trees, they were occasionally seen in cotton fields, and the stomach examinations show that about one-fourth of those killed had eaten weevils. In all, 27 stomachs of this bird were found to contain a total of 51 weevils, the largest number eaten by a single bird being 5. The small percentage of weevils taken, in comparison with the number taken by the same species at Beeville, is explained by the greater abundance of cotton worms at Runge. Practically all the orioles of the three species taken at the latter place had eaten either the caterpillars or the chrysalids of the cotton worm, and these insects formed more than 80 percent of their food.

Both the cardinal and the painted bunting were found to be eating the weevils, but neither species was abundant. Four cardinals were

examined, 2 of which had eaten a weevil. Fourteen painted buntings were taken, 2 of which had likewise eaten 1 weevil apiece.

Mockingbirds were very common, and many were seen in the fields feeding on cotton worms. Twenty-nine specimens were collected, 3 of which had taken 1 weevil apiece.

**Other localities.**—During September and October five additional localities were visited, as follows: Castroville, September 25; Seguin, September 26–29; Matthews, Colorado County, September 30–October 4; Hempstead, October 6–9, and Navasota, October 10–16. Cuero was also revisited September 6–9 and Gurley, October 17–20. At these localities, with the single exception of Cuero, weevils were found in considerable numbers, but at most places birds were remarkably scarce, and the stomachs of those collected contained no weevil remains. At Matthews, in the Colorado River bottoms, red-winged blackbirds and bronzed grackles were abundant, though comparatively few of them fed in the cotton fields.

## SCHEDULE OF STOMACH EXAMINATIONS.

In the following lists are enumerated all the species thus far examined in connection with boll-weevil investigations.[a]

*Record of birds examined which had eaten boll weevils.*

| Species. | During Jan., Feb., and Mar. | | | During Apr., May, and June. | | | During July, Aug., and Sept. | | | During Oct., Nov., and Dec. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. of birds examined. | No. eating boll weevils. | No. of boll weevils eaten. | No. of birds examined. | No. eating boll weevils. | No. of boll weevils eaten. | No. of birds examined. | No. eating boll weevils. | No. of boll weevils eaten. | No. of birds examined. | No. eating boll weevils. | No. of boll weevils eaten. |
| Killdeer (*Oxyechus vociferus*) | 2 | 1 | 3 | .... | .... | .... | 4 | .... | .... | 1 | .... | .... |
| Texan quail (*Colinus virginianus texanus*) | .... | .... | .... | .... | .... | .... | 36 | .... | .... | 108 | 1 | 1 |
| Western nighthawk (*Chordeiles v. henryi*) | .... | .... | .... | .... | .... | .... | 4 | 2 | 7 | .... | .... | .... |
| Scissor-tailed flycatcher (*Muscivora forficata*) | .... | .... | .... | .... | .... | .... | 62 | 4 | 6 | .... | .... | .... |
| Phœbe (*Sayornis phœbe*) | .... | .... | .... | .... | .... | .... | .... | .... | .... | 13 | 3 | 3 |
| Least flycatcher (*Empidonax minimus*) | .... | .... | .... | .... | .... | .... | 10 | 5 | 11 | .... | .... | .... |
| Cowbird (*Molothrus ater*) | 16 | 1 | 1 | .... | .... | .... | 54 | 3 | 3 | 24 | .... | .... |
| Red-winged blackbird (*Agelaius phœniceus*) | 3 | .... | .... | .... | .... | .... | 11 | .... | .... | 49 | 2 | 2 |
| Meadow lark (*Sturnella magna* and subspecies) | 3 | .... | .... | .... | .... | .... | .... | .... | .... | 183 | 28 | 32 |
| Western meadow lark (*Sturnella neglecta*) | .... | .... | .... | .... | .... | .... | .... | .... | .... | 66 | 12 | 18 |
| Orchard oriole (*Icterus spurius*) | .... | .... | .... | .... | .... | .... | 84 | 26 | 47 | .... | .... | .... |
| Baltimore oriole (*Icterus galbula*) | .... | .... | .... | .... | .... | .... | 27 | 6 | 10 | .... | .... | .... |
| Bullock oriole (*Icterus bullocki*) | .... | .... | .... | .... | .... | .... | 144 | 39 | 131 | .... | .... | .... |
| Brewer blackbird (*Euphagus cyanocephalus*) | 5 | 3 | 9 | .... | .... | .... | .... | .... | .... | 5 | 2 | 2 |
| Great-tailed grackle (*Megaquiscalus major macrourus*) | 8 | 2 | 2 | 2 | .... | .... | 6 | .... | .... | 2 | .... | .... |
| Western savanna sparrow (*Passerculus s. alaudinus*) | .... | .... | .... | .... | .... | .... | .... | .... | .... | 18 | 1 | 1 |
| Western lark sparrow (*Chondestes grammacus strigatus*) | .... | .... | .... | 3 | .... | .... | 51 | 1 | 1 | .... | .... | .... |
| White-throated sparrow (*Zonotrichia albicollis*) | .... | .... | .... | .... | .... | .... | .... | .... | .... | 9 | 1 | 1 |
| Cardinal (*Cardinalis cardinalis*) | .... | .... | .... | .... | .... | .... | 25 | 2 | 2 | 9 | .... | .... |
| Texan pyrrhuloxia (*Pyrrhuloxia sinuata texana*) | .... | .... | .... | .... | .... | .... | 53 | 2 | 2 | .... | .... | .... |
| Painted bunting (*Cyanospiza ciris*) | .... | .... | .... | .... | .... | .... | 107 | 18 | 19 | .... | .... | .... |
| Dickcissel (*Spiza americana*) | .... | .... | .... | .... | .... | .... | 23 | 3 | 3 | .... | .... | .... |
| White-rumped shrike (*Lanius l. excubitorides*) | 1 | .... | .... | .... | .... | .... | 9 | .... | .... | 12 | 2 | 5 |
| American pipit (*Anthus pensilvanicus*) | .... | .... | .... | .... | .... | .... | .... | .... | .... | 8 | 3 | 4 |
| Mockingbird (*Mimus polyglottos*) | 6 | 2 | 2 | 2 | .... | .... | 73 | 4 | 4 | 5 | .... | .... |
| Brown thrasher (*Toxostoma rufum*) | .... | .... | .... | .... | .... | .... | .... | .... | .... | 29 | 1 | 1 |
| Carolina wren (*Thryothorus ludovicianus*) | .... | .... | .... | .... | .... | .... | .... | .... | .... | 7 | 5 | 6 |
| Black-crested titmouse (*Bæolophus atricristatus*) | .... | .... | .... | .... | .... | .... | 1 | .... | .... | 2 | 1 | 1 |

[a] Including those examined by Bureau of Entomology.

*Record of birds examined which had not eaten boll weevils.* [a]

| Species. | Number of birds examined during— | | | |
|---|---|---|---|---|
| | January, February, March. | April, May, June. | July, August, September. | October, November, December. |
| Mourning dove (*Zenaidura macroura*) | 2 | ..... | 115 | 112 |
| Mexican ground dove (*Columbigallina p. pallescens*) | ..... | ..... | ..... | 5 |
| Yellow-billed cuckoo (*Coccyzus americanus*) | ..... | ..... | 45 | ..... |
| Texan woodpecker (*Dryobates scalaris bairdi*) | ..... | ..... | 4 | 2 |
| Red-headed woodpecker (*Melanerpes erythrocephalus*) | ..... | ..... | ..... | 3 |
| Red-bellied woodpecker (*Centurus carolinus*) | ..... | ..... | 1 | 2 |
| Golden-fronted woodpecker (*Centurus aurifrons*) | ..... | ..... | 4 | ..... |
| Flicker (*Colaptes auratus*) | ..... | ..... | ..... | 3 |
| Kingbird (*Tyrannus tyrannus*) | ..... | ..... | 8 | ..... |
| Wood pewee (*Contopus virens*) | ..... | ..... | 4 | ..... |
| Yellow-bellied flycatcher (*Empidonax flaviventris*) | ..... | ..... | 3 | ..... |
| Blue jay (*Cyanocitta cristata*) | ..... | ..... | ..... | 2 |
| Rusty blackbird (*Euphagus carolinus*) | ..... | ..... | ..... | 10 |
| Bronzed grackle (*Quiscalus quiscula æneus*) | ..... | ..... | 3 | 3 |
| Western vesper sparrow (*Poœcetes gramineus confinis*) | ..... | ..... | ..... | 11 |
| Western grasshopper sparrow (*Coturniculus s. bimaculatus*) | ..... | ..... | ..... | 5 |
| White-crowned sparrow (*Zonotrichia leucophrys*) | ..... | ..... | ..... | 4 |
| Western tree sparrow (*Spizella monticola ochracea*) | ..... | ..... | ..... | 5 |
| Fox sparrow (*Passerella iliaca*) | ..... | ..... | ..... | 9 |
| Towhee (*Pipilo erythrophthalmus*) | ..... | ..... | ..... | 6 |
| Blue grosbeak (*Guiraca cærulea*) | ..... | ..... | 3 | ..... |
| Purple martin (*Progne subis*) | ..... | ..... | 4 | ..... |
| Nashville warbler (*Helminthophila rubricapilla*) | ..... | ..... | 4 | ..... |
| Yellow warbler (*Dendroica æstiva*) | ..... | ..... | 20 | ..... |
| Mourning warbler (*Geothlypis philadelphia*) | ..... | ..... | 3 | ..... |
| Curve-billed thrasher (*Toxostoma curvirostre*) | ..... | ..... | 6 | ..... |
| Texan Bewick wren (*Thryomanes bewickii cryptus*) | ..... | ..... | 3 | 2 |
| Blue-gray gnatcatcher (*Polioptila cærulea*) | ..... | ..... | 10 | ..... |
| Bluebird (*Sialia sialis*) | ..... | ..... | ..... | 6 |

[a] A few species of which only one or two specimens have been examined are omitted from the list.

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